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QUALITATIVE AND QUANTITATIVE DISTRIBUTION OF BENTHIC MOLLUSCS ALONG THE TURKISH BLACK SEA (**)

KEY WORDS: Benthic Molluscs, Distribution, Turkish Black Sea.

Abstract

Single quantitative samples of soft-bottom benthos were collected using a van Veen grab (0.1 m^2) from 20 localities along the Turkish coasts of the Black Sea in August-September 1988 and January 1989. A total of 25,674 specimens of molluscs were collected, belonging to 37 species of Gastropods and Bivalves. The total biomass was of 2361.7 g. Most important species in abundance and frequency were *Modiolula phaseolina, Mytilus galloprovincialis, Abra alba* and *Plagiocardium papillosum.*

Sommario

Nell'agosto-settembre 1988 e nel gennaio 1989, impiegando una draga van Veen (0,1 m^2) sono stati effettuati singoli campionamenti di benthos mobile in 20 stazioni lungo le coste turche del Mar Nero. Furono raccolti in totale 25.674 esemplari di molluschi, appartenenti a 37 specie diverse di Gasteropodi e Bivalvi. La biomassa totale fu di 2361,7 g. Le specie più importanti per abbondanza e frequenza risultarono *Modiolula phaseolina, Mytilus galloprovincialis, Abra alba* e *Plagiocardium papillosum.*

Introduction

The number of the living macrozoobenthic species occurring in the Black Sea amounts to 1,785 of which 174 are Molluscs (BACESCU et al., 1971). This scarce colonization is due to complex hydrographical factors of this basin, but it can vary according to the different regions.

Few data are available on the mollusc fauna of the southern Black Sea. Firstly, OSTROUMOV (1893; 1896; cf. ZENKEVICTH, 1963) studied the benthos present in the first 20 m in the Strait Bosphorus, but ZERNOV (1913; cf. ZENKEVICTH, 1963) was the first to study quantitatively the benthic communities present in the Black Sea. More recently, DEMIR (1954) studied the benthic marine invertebrates of the Turkish Straits and Islands in the Sea of Marmara.

Material and Methods

The processing (seiving, sorting, preserving, weighing etc.) of the soft-bottom samples were made according to the STIRN's (1981) recommendations. The analytical methods (frequency, occurrence and dominance) used in this study were based on those of HOLDEN & RAITT (1974). Frequency is expressed as the percentage of total frequency of each species within total frequency of all species in the sampling area. The occurrence is defined as the total individual percentage of each species among total individuals of all species in whole studied region. Finally, the qualitative distribution or occurrence percentage of each species among stations is the dominance.

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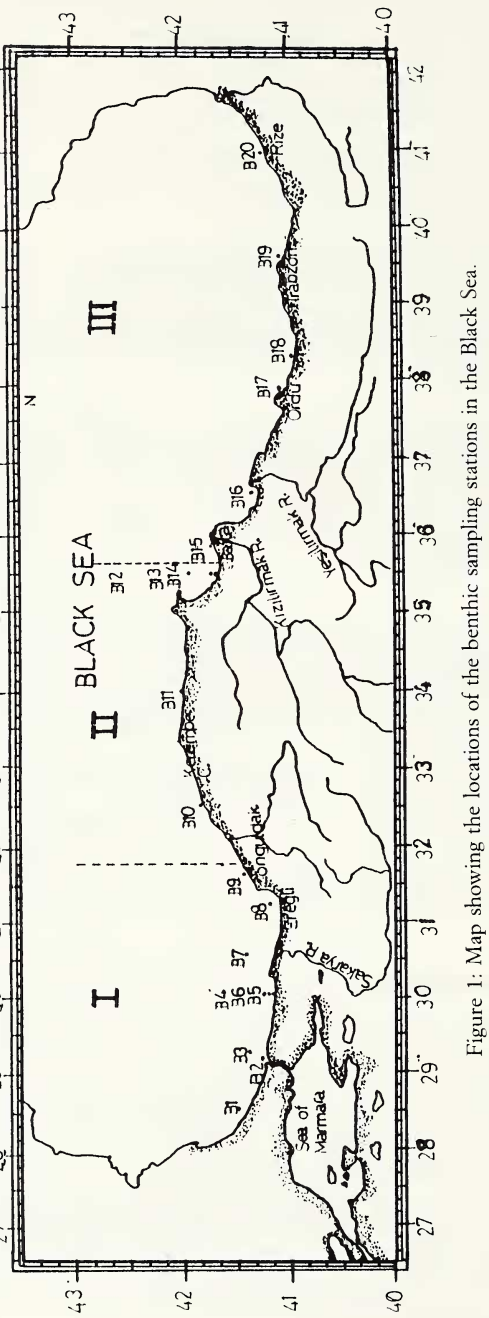

Figure 1: Map showing the locations of the benthic sampling stations in the Black Sea.

Results and Discussion

Qualitative distribution and species composition

This preliminary study yielded 36 taxa of Molluscs from the Turkish coasts of the Black Sea.

Gastropoda Prosobranchia: This subclass is represented by 26% species dominance in the whole sampling area. In this study, only 11 gastropods could be found, although 96 species were recorded from the Black Sea (Zenkevicth, 1963).

The sandy and muddy bottoms ranges from 15 to 30 m in the Black Sea and are inhabited by many molluscs and the species belonging to the genera *Nassarius* and *Pusillina* are considered the common gastropods of this zone in the Black Sea (Sorokin, 1983). Moreover gastropods are frequent in the phaseolin ooze at a depth of more than 40 m (Borcea, 1936; cf. Zenkevicth, 1963). According to Shopov (1978) along the Bulgarian coasts, *Bittium reticulatum* is frequently observed at depths of 30-40 m, where it is accompanied by *Ventrosia ventrosa*.

In the present study carried on along the Turkish coasts, 7 prosobranchs (Figs. 2-4) were collected and *Trophon muricatus, Bittium reticulatum* and *Ventrosia ventrosa* can be considered common at Stations B7, B10 and B16, in depths ranging from 35 to 80 m. The last two species were found at five stations, where they are very dense at depths of 40-48 m. The more rare *Cyclope neritea* was sampled at the Station B 14, at 28 m depth.

The station B15, close to the delta of the Kizilirmak River, off Bafra, is rich in species. The water input of this stream may contain enough nutrients for the phytoplankton and this favour the macrozoobenthic filter-feeders. Another factor which could explain the occurrence of more macrobenthic species near the mouth of the river is the existence of coarse material in this area. In fact, the sediment texture in the coastal waters is controlled by the surface currents and the superficial sediments contain a large amount of coarse material.

Gastropoda Opistobranchia: Only four opisthobranchs were identified from this area. Of these species, *Retusa truncatula* was frequently sampled (Figs. 2-3) and found at 35% of the stations. This species usually prefers silty clay bottoms.

According to Shopov (1979), along the Bulgarian coasts, *Retusa truncatula* and some other gastropods, e.g. *Ventrosia ventrosa* and *Trophon muricatus*, lives in greenish grey mud, at depths of 30 to 60 m, in the so-called *Ventrosia ventrosa* community (Krischev & Shopov, 1978).

Other opisthobranchs found more rarely in the investigated area were *Chyrsallida obtusa* and *Cylichnina umbilicata (=Retusa umbilicata)* (Figs. 2-3).

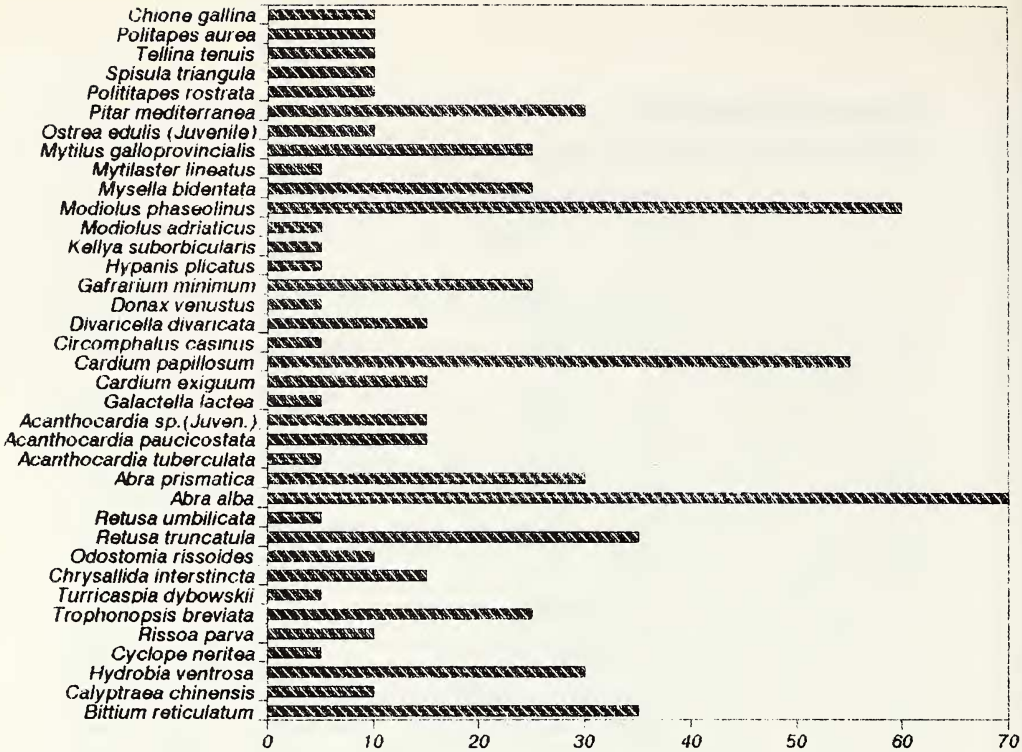

Figure 2: Dominance of species. %

Figure 3: Frequency of occurrence among the species. %

Bivalvia: Bivalves are the largest class, with 25. collected species which constitute 70% of all species collected throughout this study along the southern Black Sea coasts. Until now 49 species of bivalves were recorded in the Black Sea (Caspers, 1957; Zenkevicth, 1963).

The most frequent recorded species were *Abra alba*, *Plagiocardium papillosum* and *Modiolula phaseolina* (Figs 2-3). Among these, *Abra alba* was identified in the 70% of the stations. This species lives at a depth ranging from 28 m to 112 m. Such species, particularly *Abra alba* and *Plagiocardium papillosum* inhabit the mussel mud present between 10 to 30 m and mostly the phaseolin ooze, extending from 55 m to 180 m in the Black Sea (Yakobova, 1935; cf. Zenkevicth, 1963). Also Borcea (1936; cf. Zenkevicth, 1963) pointed out that such bivalves could generally dwell in the phaseolin ooze which extends from 55-65 m to 180-185 m depths along the continental shelf of the northern coasts of the Black Sea. At this depth, the type and texture of the bottom sediment are silt or silty mud which was deposited by the fecal pellets of its own filter-feeding bivalve: *Modiolula phaseolina*. This species is an interesting example of the ecological aspects of the Mediterranean fauna in the Black Sea. It is relatively rare in the Mediterranean Sea, but commoner in the Atlantic Ocean as far as to Norway, and particularly abundant off the shores of England (Zenkevicth, 1963). In the Black Sea, it occurred most frequently at depths of 65 to 100 m on the soft bottom, not rising above 40 m and not sinking below 180 m (Jakubova, 1948; cf. Zenkevitch, 1963).

On the shelf bottom, *Mytilus galloprovincialis* was observed especially at depths less than 40 m. Offshore Eregli and Bafra, this mussel lives generally between 20 to 40 m depth.

M. phaseolina begins to re-appear below 50 m and extends to 150-160 m along the Rumanian coasts (Bacescu et al., 1971). *Abra alba* is well concentrated in the shallower waters of Sulina and Odessa where there is a river discharge to the Black Sea (Bacescu et al., 1971).

Other not so common bivalves are: *Lucinella divaricata*, *Chamelea gallina*, *Donax venustus*, *Venerupis aurea* and *Mytilaster lineatus* (Figs. 2-3). These species were mainly found at station B 20 at 20 m depth close Rize, where the sea bottom is sandy (93%). Zenkevicth (1963) classified some molluscs as characteristic of the sandy bottoms of the Black Sea: *Chamelea gallina*, *Gouldia minima*, *Lucinella divaricata*, *Spisula subtruncata*, *Parvicardium exiguum* and *Pitar rudis*. The fine sand bottoms along the Russian coasts between 15 to 28 m depth are well-inhabited by these species (Caspers, 1957) and a similar fauna was described along the Rumanian coasts, between 6 and 15 m (Borcea, 1927; cf. Caspers, 1957). From the results of the study carried out by Bacescu et al. (1971). in the Rumanian sector, *Gouldia minima*, *Lucinella divaricata* and *Chamelea gallina* were mostly located around a depth of 20 m, off the Varna.

Apart from these bottom types, a gravel substratum containing 73 % of gravel in its sediments (Tab. 3) was observed only at station B 2. Only one species, *Striarca lactea* was sampled. This species was reported by Demir (1954) to dwell on the shelly-gravel substratum.

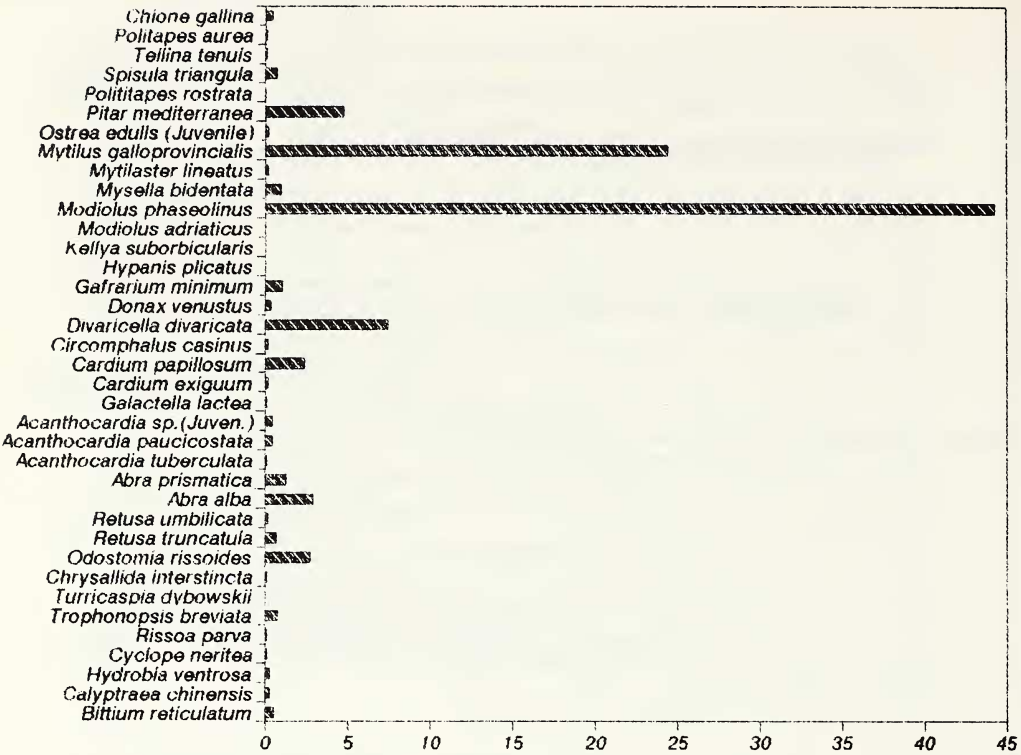

Figure 4: Numerical occurrence of the species. %

Maximum species number (20 spp./m²) was found at station B 14 (Fig. 1) and at Station B 15 (19 spp./m²). These stations are placed at the depths of 28 and 36 m respectively, around the river of Kizilirmak off Bafra in the middle part of the southern Black Sea. They have a silty bottoms, but the sediment texture of station B15 is more homogeneous than that of station B14. The stations B20 at 40 m, B8 at 34 m, B5 at 58 m and B6 at 44 m have had 11, 12, 10 and 10 species per m², respectively. The stations in the off-shore region, such as B7 and B12, have less species and B3 had no species (Tab. 4). Hence, the species number of coastal waters was greater than that of the open water. Depending on the depth of the stations, the species number increases from the west to the east in the studied area. The stations which are close to delta front of the rivers, such as B15 and B16 are rich in the dissolved oxygen content, in detritus and in sinking nutrient materials. This is very important for such filter-feeders as many bivalves. The oxygen content of station B 6,containing moderate number of species (13) was 6.79 ml/l. The stations in deep waters with a low oxygen content are found to have low species number. For example, the locations having the oxygen content between 1 and 3 ml/l had 1 to 4 mollusc species. At the stations where the waters have low oxygen content, three common species, *Modiolula phaseolina*, *Abra alba* and *Plagiocardium papillosum*, were found. In a study carried out by Dries (1978), it was announced that *Abra alba* can

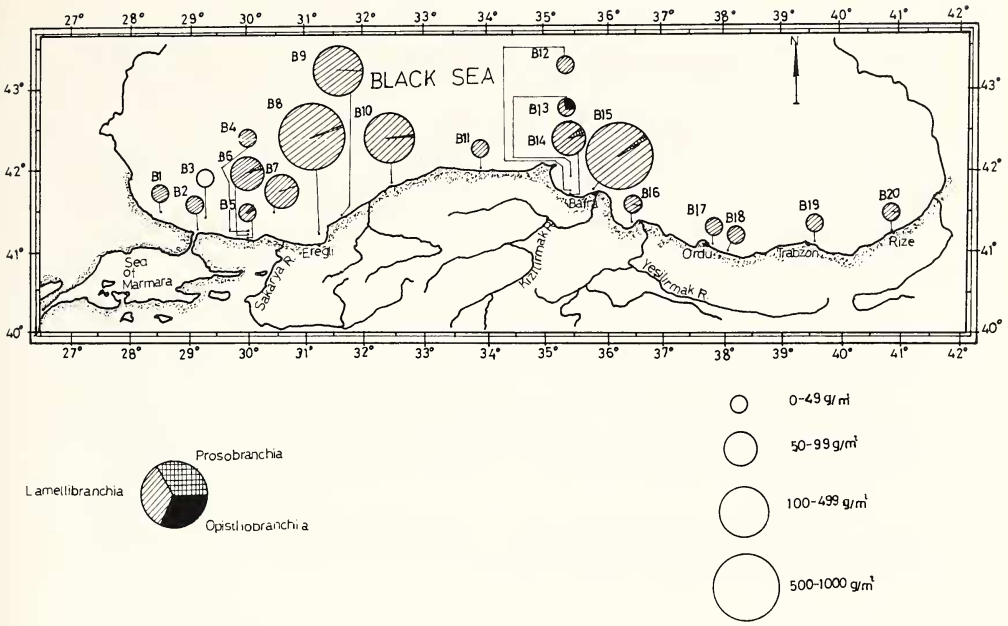

Figure 5: Map showing total biomass contribution of macrobenthic mollusc subclasses at the sampling stations (From MUTLU et al., 1993).

activate metabolic functions under oxygen deficiency. It was pointed out that the utilization of the food reserves during the exposure to anaerobic water and the recovery of respiration after oxygen deficiency were determined for *Abra alba*.

As a result, the species number and composition could depend on several environmental factors. In this study, the molluscs decrease when the depth increases, but increase with the dissolved oxygen content of the deep waters.

Quantitative distribution

In the material collected at all stations in the southern Black Sea (20 m^2), 37 mollusc species had 25,674 individuals and yielded 2361.25 g of biomass.

Gastropoda: Gastropods were represented by only 11 species and by 7.49% of the total biomass. The total abundance was 1,483 individuals in all sampling area. Prosobranchs was found to have 7 species: *Bittium reticulatum*, *Ventrosia ventrosa* and *Trophon muricatus*, generally inhabiting the phaseolin mud (usually at depth 40 to 130 m), were the most abundant species. The maximum biomass (Fig. 5) and abundance for these small gastropods were as follows: *Trophon muricatus*: 2.4 g/m^2, 80 ind./m^2 at station B15; *Bittium reticulatum*: 97 mg/m^2, 63 ind./m^2 at station B15 (36 m) and *Ventrosia ventrosa*: 41 mg/m^2, 29 ind./m^2 at station B8 (34 m).

This last species, in the Azov Sea inside the «*Ventrosia ventrosa community*» reachs 14,321 ind./m² with a biomass of 14.85 g/m² (Casper, 1957). In the Bulgarian coasts, it constitutes 61.6% of the total abundance inside the same community at 30-60 m depth (Shopov, 1973).

The *Bittium reticulatum* was encountered by the 19.4% of the total abundance in the «*Spisula subtruncata* community» which was concentrated between the depths of 30-45 m along the Bulgarian coasts (Shopov, 1979). *Trophon muricatus* was found to have the maximum abundance (440 ind./m²) at the depths of 50-60 m along the Rumanian coasts and it almost disappeared (1-10 ind./m²) below 40 m depth (Bacescu et al., 1971).

Among Opisthobranchs, *Odostomia scalaris* was the most abundant (Fig. 4) although it was identified at only two stations (B5 and B15). The species biomass was weighed as 170 mg/m² (145 ind./m²) at station B5 (94 m) and 857 mg/m² (566 ind./m²) at station B 15 (36 m) along the Anatolian coasts of the Black Sea. The second species, *Retusa truncatula*, was found to have the maximum number (46 ind./m²) and 46 g/m² at station B15.

Bacescu et al., (1971) reported that *Odostomia scalaris* was generally sampled in the west and the northwestern parts of the Rumanian coasts. Retusa truncatula often appeared between 40-50 m depths along the Rumanian coasts especially offshore Sulina.

Bivalvia. The total biomass and abundance of the bivalves, with the 25 species, was recorded as 2.4 kg and 24,191 specimens in the whole sampling area (20 m²).

The most abundant species were *Modiolula phaseolina* and *Mytilus galloprovincialis* (Fig. 4). Such bivalves are known as fouling organisms (Dolgopol'skaya, 1954; cf. Zenkevicht, 1963). *M. phaseolina* biomass is 660 g with 11,377 specimens, while *M. galloprovincialis* biomass is 1,486.2 g at 6,275 individuals were recorded in the whole sampling area. The maximum biomass was 228.5 g/m² at the station B 9 at 3,297 ind./m² for *M. phaseolina* and 748.5 g/m² at the station B8 at 2,526 specimens/m² for *Mytilus galloprovincialis*. According to Arnoldy (1941; cf. Zenkevicht, 1963), in the small area of the southern coasts of the Crimea (from Cape Fiolent to Alupka), the mean biomass of *Modiolula phaseolina* was 779 g/m² at 10,700 ind./m² and that of *Mytilus galloprovincialis* was 464 g/m² at 185 ind./m². These data also closely follow Wodjanitzky's result (cf. Zenkevicth, 1963). In the phaseolin mud (60-180 m) the density of *Modiolula phaseolina* population was several hundreds per square meter (Sorokin, 1983). In the Rumanian Black Sea coasts at Mamaia, under conditions of eutrophication, the mytilid mussel was found to have the maximum values of 1,510 ind./m² at the biomass of 29.08 g/m² (Gomoiu, 1988). Marinov & Golemansky (1988) reported that the average biomass of *Modiolula phaseolina* was 710 g/m² and the abundance 11000 ind./m² or more on the bottom deeper than 60 m along the Bulgarian littoral zone. The average specimen number of *M. phaseolina* was recorded to be 10,000 ind./m² on the continental shelf of the Black Sea (Karandieva, 1959; cf. Bacescu & Acad, 1971). But the mussel bed decreased since the presence of its predator, *Rapana venosa* along the Bulgarian continental shelf (Marinov, 1987). The maximum number of spe-

cimens reached 1,500 specimens/m² at 60 to 75 m and the greatest biomass 2,000 g/m² at 35 to 50 m along the Anatolian coasts (NIKITIN, 1938 cf. ZENKEVICTH, 1963).

On the sandy and silty bottom, the predominant species were *Lucinella divaricata* of 1,891 ind/m² at the biomass of 110.2 g/m²m *Chamelea gallina* of 354 ind./m² at the biomass of 26.9 g/m² (20 m, station B20) and *pitar rudis* of 1,131 ind./m² at of the biomass of 48.3 g/m² (28 m, station B14) in the studied area. On sandy and silty bottoms of the Caucasian coasts, *L. divaricata* was found to have the mean value of 858 ind./m² and 5.8 g/m² at depths of 15-30 m. The mean specimens number and biomass for *Chamelea gallina* was 248 ind./m² and 5.8 g/m² on the silty sand bottom. In the present study, *Donax venustus* was observed with a biomass of 8.6 g/m² and 86 ind./m² only at station B20 at which the bottom contained 93% of sand, off Rize in the Turkish coasts. ZENKEVICTH (1963) calculated, from the ARNOLDY's data, that the average specimens number and biomass of this species was 21 ind./m² and 6.7 g/m² in the coastal pure sand off Caucasian in the Black Sea.

Although *Abra alba* and *Plagiocardium papillosum* were the representative of the most frequent mollusc species in the Anatolian coasts, however, the abundance and the biomass of them was very low compared with the other bivalves.

Abra alba is a common bivalve of the Black Sea and inhabits particularly the soft bottom after 40 m depth. *Plagiocardium papillosum* lives also at the same depth in the Black Sea (CASPERS, 1957). In this study, these species were found to have the following maximum values: the specimens number and biomass of *Abra alba* were 131 ind./m² and 2.2 g/m² at the depth of 44 m (station B6), while they were 126 ind./m² and 2.6 g/m² at the depth of 48 m (station B15), for *C. papillosum* in the Anatolian coasts. On the mussel mud (30-50 m) in the Caucasian coasts, the mean biomass and abundance of these species were as follows: 10 g/m² at 63 specimens/m² for *Plagiocardium papillosum* and 4.5 g/m² at 47 ind./m² for *Abra alba* (ZENKEVICTH, 1963). *Abra alba* was observed to have 130 ind./m² at the depth of 50 m off Constanta in Rumania. *Plagiocardium papillosum* was found to be 20 ind./m² at 47 m and 10 ind./m² at the depth of 63 m in the Constanta coasts, but 200 ind./m² at depths of 100-170 m off Bosphorus in the Black Sea (BACESCU et al., 1971).

Conclusion

Only two mollusc classes (Gastropoda: subclasses Prosobranchia, Opisthobranchia and Lamellibranchia: subclasses Pteromorphia, Heterodonta) were distinguished.

11 species of Gastropoda and 25 of Lamellibranchia were found. The total abundance of the molluscs along the Turkish coast of the Black Sea was found to be 25,674 specimens which had a total biomass of 2361 g. The individual number varies from 12 to 7858 ind./m², the species from 1 to 20 spp./m² and the biomass between 0.401 and 808 g/m² among the stations.

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